What is claimed is:

<u>Basic Method with Respect laser deposition to of a layer of Gallium Arsenide upon Silicon Substrate</u>

1. A method of laser deposition of a layer of gallium arsenide upon a silicon substrate, said method comprising the steps of:

(a) providing in a vacuum:

(1) a target comprising a target surface bearing gallium arsenide; and
(2) a substrate comprising a substrate surface bearing silicon;

wherein said target surface and said substrate surface are in opposed alignment; and

(b) irradiating said gallium arsenide with a laser so as to vaporize said gallium arsenide, so as to cause said gallium arsenide to be deposited upon said silicon uniformly and in a substantially stoichiometric ratio.

2. A method according to claim 1 wherein said target surface and said substrate surface are in substantially parallel alignment.

3. A method according to claim 1 wherein said target surface and said substrate surface are disposed at an angle to one another.

4. A method according to claim 1 wherein said layer of gallium arsenide deposited upon said silicon in has a smoothness variation is less than 100 nanometers.

5. A method according to claim 1 wherein said layer of gallium arsenide deposited upon said silicon in has a smoothness variation is less than 20 nanometers.

6. A method according to claim 1 wherein said target surface is irradiated with a laser of sufficient power so as to cause said gallium arsenide to be explosively vaporized and deposited upon said substrate surface.

7. A method according to claim 1 wherein said target surface consists essentially of gallium arsenide.

8. A method according to claim 1 wherein said substrate surface consists essentially of silicon.

9. A method according to claim 1 wherein said target surface consists essentially of substantially pure gallium arsenide.

10. A method according to claim 1 wherein said substrate surface consists essentially of substantially pure silicon.

11. A method according to claim 1 wherein said target surface consists essentially of substantially pure gallium arsenide.

12. A method according to claim 1 wherein said gallium arsenide is n-doped.

13. A method according to claim 1 wherein said gallium arsenide is p-doped.

14. A method according to claim 1 wherein said silicon is n-doped.

15. A method according to claim 1 wherein said silicon is p-doped.

16. A method according to claim 1 wherein said silicon and said gallium arsenide are non-doped.

17. A method according to claim 1 wherein said target surface and substrate surface are disposed at a distance in the range of from about 1.0 cm to about 20 cm.

18. A method according to claim 1 wherein the applied laser fluence of said laser light is in the range of from about 0.3 J/cm^2 to about 2.5 J/cm^2.

19. A method according to claim 1 additionally comprising moving said target with respect to said substrate during step (b).

20. A method according to claim 1 additionally comprising moving said target surface within the plane defined thereby during step (b).

21. A method according to claim 1 additionally comprising moving said substrate with respect to said target during step (b).

22. A method according to claim 1 additionally comprising moving said substrate surface within the plane defined thereby during step (b).

23. A method according to claim 1 additionally comprising rotating said target about an axis perpendicular to said target surface during step (b).

24. A method according to claim 1 additionally comprising rotating said substrate about an axis perpendicular to said substrate surface during step (b).

More Specific Method with Respect laser deposition to of a layer of Gallium Arsenide upon Silicon Substrate

25. A method of laser deposition of a layer of gallium arsenide upon a silicon substrate, said method comprising the steps of:

(a) providing in a vacuum:

(1) a target comprising a target surface bearing gallium arsenide; and
(2) a substrate comprising a substrate surface bearing silicon;

wherein said target surface and said substrate surface are in opposed alignment; and

(b) irradiating said gallium with a laser of sufficient laser fluence so as to cause said gallium arsenide to be explosively vaporized and deposited upon said substrate surface, so as to cause said gallium arsenide to be deposited upon said silicon uniformly and in a substantially stoichiometric ratio, and whereby said layer of gallium arsenide deposited upon said silicon in has a smoothness variation is less than 20 nanometers.

26. A method according to claim 25 wherein said target surface and said substrate surface are in substantially parallel alignment.

27. A method according to claim 25 wherein said target surface and said substrate surface are disposed at an angle to one another.

28. A method according to claim 25 additionally comprising moving said target with respect to said substrate during step (b).

29. A method according to claim 25 additionally comprising moving said substrate with respect to said target during step (b).

30. A method according to claim 25 additionally comprising moving said target so as to move said target surface within the plane defined thereby during step (b).

31. A method according to claim 25 additionally comprising moving said substrate so as to move said substrate surface within the plane defined thereby during step (b).

32. A method according to claim 25 additionally comprising said rotating said target about an axis perpendicular to said target surface during step (b).

33. A method according to claim 25 additionally comprising rotating said substrate about an axis perpendicular to said substrate surface during step (b).

Layered Article of Gallium Arsenide upon Silicon Substrate

34. A layered article comprising:

(a) a first layer comprising silicon; and
(b) a second layer comprising gallium arsenide

said gallium arsenide of said first layer being layered onto said silicon of said second layer uniformly and in a substantially stoichiometric ratio, and whereby said layer of gallium arsenide deposited upon said silicon in has a smoothness variation is less than 100 nanometers.

35. A layered article method according to claim 34 wherein said gallium arsenide is n-doped.

36. A layered article according to claim 34 wherein said gallium arsenide is p-doped.

37. A layered article according to claim 34 wherein said silicon is n-doped.

38. A layered article according to claim 34 wherein said silicon is p-doped.

39. A layered article according to claim 34 wherein said gallium arsenide is n-doped and wherein said silicon is p-doped.

40. A layered article according to claim 34 wherein said gallium arsenide is p-doped and wherein said silicon is n-doped.

41. A layered article according to claim 34 wherein said silicon and said gallium arsenide are non-doped.

Electronic Devices and Circuits Comprising the Layered Article of Gallium Arsenide upon Silicon Substrate

42. An electronic circuit comprising a rectifier, said rectifier comprising a layered article comprising:

(a) a first layer comprising silicon; and
(b) a second layer comprising gallium arsenide

said gallium arsenide of said first layer being layered onto said silicon of said second layer in a substantially stoichiometric ratio, and whereby said layer of

gallium arsenide deposited upon said silicon has a smoothness variation less than about 100 nanometers.

43. A tunable photodiode comprising:

(a) a diode structure having an input and output contacts, and comprising:

(i) A first layer comprising silicon; and
(ii) a second layer comprising gallium arsenide;

said gallium arsenide of said first layer being layered onto said silicon of said second layer in a substantially stoichiometric ratio, and whereby said layer of gallium arsenide deposited upon said silicon in has a smoothness variation is less than 100 nanometers; and

(b) an adjustable source of electrical potential connected to said input and output contacts, whereby the peak wavelength sensitivity of said diode to incident light thereupon may be tuned through application of said electrical potential.

<u>Memory/Logic/Multiplexer Devices including a Layered article of Gallium Arsenide upon Silicon Substrate</u>

44. A memory device comprising:

(a) a field effect transistor comprising a GaAs/Si composite comprising:

(i) a first layer comprising silicon; and
(ii) a second layer comprising gallium arsenide;

said gallium arsenide of said first layer being layered onto said silicon of said second layer uniformly and in a substantially stoichiometric ratio.

45. A logic device comprising:

(a) one or more input lines associated with one or more output lines according to a logic algorithm;

(b) at least one signal input device associated with said one or more input lines, and least one signal output device associated with said one or more output lines;

at least one of said at least one signal input device and at least one signal output device being optical or electrical; and

(c) a logic algorithm device for associating said one or more input lines associated with one or more output lines, said device comprising:

(i) a first layer comprising silicon; and
(ii) a second layer comprising gallium arsenide;

said gallium arsenide of said first layer being layered onto said silicon of said second layer uniformly and in a substantially stoichiometric ratio.

46. A multiplexer device comprising:

(a) a plurality of input lines associated with a respective number of data sources, and an output line, and
(b) a data selector;

each of said input lines adapted to transfer data to said output line when said data selector selects it, said data selector comprising:

(i) a first layer comprising silicon; and
(ii) a second layer comprising gallium arsenide;

said gallium arsenide of said first layer being layered onto said silicon of said second layer uniformly and in a substantially stoichiometric ratio.

47. A multiplexer device according to claim 32 wherein said plurality of input lines are optical input lines and wherein said output line is an electrical output line, and wherein the data on the optical input line once selected by the data selector is converted and transferred to the electrical output line when a bias voltage is applied to said device.

Apparatus for Producing GaAs/Si Composites

48. An apparatus for producing GaAs/Si composites by laser ablation, said apparatus comprising:

(a) a source of a beam of laser light;
(b) a chamber adapted to maintain a vacuum in its interior while allowing passage of said beam of laser light into its interior;
(c) a target comprising a target surface and disposed in said chamber and in the path of said beam of laser light, said target surface bearing gallium arsenide;
(d) a substrate comprising a substrate surface and disposed in said chamber, said substrate surface bearing silicon, and aligned in opposed alignment; and

wherein source of laser light is of sufficient power, and said target surface and substrate surface of at such sufficient proximity that, when said target surface is irradiated, said gallium arsenide vaporizes and is deposited upon said silicon uniformly and in a substantially stoichiometric ratio.

49. A method according to claim 48 wherein said target surface and said substrate surface are in substantially parallel alignment.

50. A method according to claim 48 wherein said target surface and said substrate surface are disposed at an angle to one another.

51. An apparatus according to claim 48 wherein said laser light is provided by a pulsed laser.

52. An apparatus according to claim 48 wherein said target surface and substrate surface are disposed at a distance in the range of from about 1.0 cm to about 20 cm.

53. An apparatus according to claim 48 wherein the applied laser fluence of said laser light is in the range of from about 0.3 J/cm^2 to about 2.5 J/cm^2.

54. An apparatus according to claim 48 additionally comprising a moveable support attached to said target so as to be capable of moving said target with respect to said substrate.

55. An apparatus according to claim 48 additionally comprising a moveable support attached to said target so as to be capable of moving said target surface within the plane defined thereby.

56. An apparatus according to claim 48 additionally comprising a moveable support attached to said substrate so as to be capable of moving said substrate with respect to said target.

57. An apparatus according to claim 33 additionally comprising a moveable support attached to said substrate so as to be capable of moving said substrate surface within the plane defined thereby.

58. An apparatus according to claim 33 additionally comprising a rotating support attached to said target so as to be capable of rotating said target about an axis perpendicular to said target surface.

59. An apparatus according to claim 33 additionally comprising a rotating support attached to said substrate so as to be capable of rotating said substrate about an axis perpendicular to said substrate surface.